

United States Department of Agriculture
Bureau of Entomology and Plant QuarantineREPORT ON A SURVEY IN SOUTH AMERICA OF THE WHITE-FRINGED
BEETLE AND ITS NATURAL ENEMIESBy Paul A. Berry,
Division of Foreign Parasite Introduction

INTRODUCTION

Naupactus leucoloma Boh. was first reported in the United States in the Bureau News Letter, dated September 1, 1936, as doing damage to peanuts. Subsequent investigations by various workers and especially those of H. C. Young, B. A. App, G. D. Green, and R. N. Dopson, Jr., published in Circular E-420, January 1938, show that this insect is a pest of economic importance and that it attacks and causes serious injury to a number of cultivated crops in the United States. This beetle was known to be of South American origin, where it had never been reported as doing damage to any agricultural crops. A survey of the South American areas from which adult beetles had been reported, covering the period from September 1938 to April 1939, was undertaken in order to study it in its native habitat, get a true picture of its economic importance and, if possible, find some natural enemy that would be of value in controlling the beetle in the United States. Accordingly a survey of several provinces of Argentina, Uruguay, and part of Brazil has been made, and the results are given in this report. Studies were made in Argentina during September 1938 to January 1939, in Uruguay during January and February 1939, and in southern Brazil in March and April 1939. The points at which observations were made are shown on the accompanying map. The project has been under the direction of C. P. Clausen, in charge of the Division of Foreign Parasite Introduction.

METHODS

Original plans for investigating the density of Naupactus larval populations in South America were based, to a great extent, on the methods used by Young, App, Green, and Dopson, at Florala, Ala. The original idea was to take five 1-square-yard samples of soil in each field and from these samples determine the larval concentrations, vertical distribution, and economic importance of the insect. These samples were to be taken, one in the center and one in each of the four corners of each field sampled. This method was used almost exclusively the first few days but resulted in the finding of very few Naupactus larvae. However, throughout the project an attempt was made to use these 1-square-yard samples as a basis for determining the densities of larval populations.

Samples were taken in alfalfa, corn, cotton, cowpea, velvetbean, vetch, potato, pastures, and in wild plants along roadsides, fence rows, and railroad rights-of-way. Naupactus larvae were found in practically all types of plant growth observed, but in such limited numbers in most cases as to be of little value in the search for natural enemies or other controlling factors. The heaviest concentrations were found in alfalfa fields of 3 to 5 or more years' standing, but even in alfalfa random samples showed a very low population.

After a few days' experience it was found that infestations in alfalfa could be detected, in many cases, by observing the physical condition of the plants. In some fields there were dead, dying, or wilted areas of 1 to 10 square yards or more, and soil samples in these areas showed, in many cases, that the damage was due to Naupactus larvae feeding on the plant roots. Samples were taken in these most heavily infested areas in order to obtain data on the heaviest concentrations and also to obtain sufficient larvae for observation on natural enemies or other controlling agencies.

Other methods used in attempting to obtain data on the intensity of infestations were to allow laborers to examine the soil at random and calculate the number of larvae per hour per laborer. In some cases samples of 50 or 100 alfalfa plants were taken at random and the roots examined for signs of injury by larval feeding.

In several of the regions visited the farmers were cultivating the soil in preparation for seeding, and advantage was taken of these opportunities to follow plows and look for soil-inhabiting larvae.

Field, garden, and truck crops of all types were also examined for poor stands, wilted plants, and areas that were killed out or were in a condition of poor growth. Plants that appeared unhealthy were dug up and the roots examined. Markets were visited in most regions, and root, tuber, and bulb crop products were examined for injury by soil-inhabiting larvae.

In searching for adults, sweepings with an insect net were made in practically all types of cultivated crops and wild plants. All signs of feeding injury were carefully observed, and where injury was noted the plants were carefully examined, and the areas around the bases of the plants were also inspected.

The search for eggs, although futile, consisted in pulling up the plants and examining the stalks and upper parts of the roots, as well as examining the grass roots and stems and debris in the areas where adult naupactines were found feeding.

AREAS IN WHICH OBSERVATIONS WERE MADE

The survey for observations on the biology and the search for parasites of the white-fringed beetle were conducted in as many distinct life zones as possible. In Argentina investigations were carried on in

Calilegua, Ledesma, Jujuy, Salta, Guemes, Tucuman, Santiago del Estero, Fernandez, Santa Fe, Concordia (Entre Rios), Pergamino, Sarimento, San Antonio de Areco, Jose C. Pas, Buenos Aires, La Plata, General Pico (Gobernacion La Pampa), San Juan (Province San Juan), Mendoza, and San Luis.

In Uruguay observations were made in the following areas: Montevideo, Mercedes, Colonia, Paysandu, Salto, and along the main road to Punta del Este and in Rivera.

In Brazil observations were made in Sant'Anna, Santa Maria, Santa Cruz, Porto Alegre, Passo Fundo, Sao Paulo, Campinas, the agricultural areas between Campinas and Riberom Preto, and in the vicinity of Rio de Janeiro.

During the whole course of the investigations no extensive heavy infestations were found. It is difficult to measure or estimate the economic importance of Naupactus leucoloma, as a whole or even in those sections where it occurs in the greatest numbers. The infested areas, in general, were so small that no adequate method was developed for evaluating the extent of the injury. Estimates were based, for the most part, on square-yard samples of soil the damage to roots of alfalfa plants, and the extent of the areas in fields showing poor growth or those that were killed out by root-feeding larvae.

DISCUSSION OF CONDITIONS IN THE DIFFERENT ZONES VISITED

Calilegua and Ledesma.--This area is located in the northwestern part of Argentina in the Province of Jujuy. The principal crops are sugarcane and citrus. In addition to these, bananas, alfalfa, some legume cover crops, and a variety of truck and garden crops, for local consumption, are grown.

All types of plant growth were examined and the soil was sampled in various areas, but no Naupactus larvae were found in this region. Examinations of the roots of alfalfa plants revealed no indications of past or present injury by any type of larvae.

Jujuy.--There is a fine agricultural zone in the vicinity of Jujuy, and quite a variety of cultivated crops are produced. The principal enterprises are beef and dairy products. The cultivated crops consist of alfalfa on a rather large scale, corn, legumes, wheat, oats, various citrus fruits, and apples.

Soil samples were taken in all the above types of plant growth, but few larvae were found and practically all these were in the alfalfa fields. Populations of 12, 23, 30, and 14 larvae per square yard were found, but these instances were very rare and so limited in extent that it was difficult to get sufficient larvae for study. Random sampling indicated a very low population, and two laborers averaged only four larvae per hour when sampling various alfalfa fields. A total of only 240 Naupactus larvae were obtained in this area; 25 of these were dis-

sected, a sample was sent to Washington, D. C., and the remainder kept for rearing.

Salta.--The principal crops observed in this area were corn, oats, legumes, alfalfa, and truck and garden crops. Light infestations of 1, 8, 7, and 10 Naupactus larvae to the square yard were found, and there was very little damage to alfalfa roots in any of the fields examined. Only 100 larvae were found in this area and most of these were obtained by digging up isolated dead alfalfa plants. Twenty of the 100 larvae were dissected.

Guemes.--Corn, cotton, alfalfa, and various types of legumes, as well as garden crops, were observed in this area. The cotton stalks had been left in the field since last year, and the stands were good, with very few plants missing. The corn stands were good, and there was no noticeable damage to any type of crops produced in this region. The alfalfa fields were remarkably free of Naupactus larvae.

A total of 125 larvae were found in a field that had been in "garabanzos" the year before. The field was being plowed for seeding, and several of the larvae were found by following the plow or digging into the plowed ground. A few larvae were also found in the unplowed land near where the beans had been grown. A sample of 25 larvae were dissected, a sample was sent to Washington, D. C., for determination, and the rest were kept for rearing.

Tucuman.--This area includes Santa Barbara, Lules, and Garcia Fernandez. The principal crop in this zone is sugarcane, although a considerable effort is being made to induce the farmers to increase the production of cotton.

The Tucuman Experiment Station produces a variety of crops, including sugarcane, alfalfa, cotton, sweetpotatoes, wheat, cowpeas, some velvetbeans, oats, vetch, and citrus. The same types of plants are produced throughout this whole area to a more or less limited extent, and in addition a variety of garden and truck crops are grown for local consumption.

Soil samples were taken in all types of crops observed, but Naupactus larvae were found only in alfalfa on the experiment station grounds. In Lules larvae were found in one field that had been planted to cowpeas the year before the investigations were made.

Concentrations of larvae in alfalfa plots were as follows: 1-square-yard samples in one alfalfa plot that showed no indications of injury contained 5, 20, 44, and 33 larvae each. Samples taken in this field, where the stands were poor, or contained dead plants, contained infestations ranging as high as 200, 212, 97, 123, 65, and 184 larvae per square yard. Other samples in the same field failed to produce any larvae. Samples taken in other alfalfa plots on the experiment station grounds were practically free of larvae. In Santa Barbara several al-

alfalfa fields were sampled, but larvae were found only in one small plot. This small area had populations of 10, 16, and 8 larvae per square yard.

In Lules samples taken in fields that had cowpeas last year had larval populations of 8, 16, 45, 11, and 6 per square yard. One alfalfa field in this area had 15, 18, 6, 23, 44, and 19 larvae per square yard, but in most alfalfa fields it was difficult to find Naupactus larvae.

In Garcia Fernandez it was difficult to find larvae and only one small plot of alfalfa was found infested; this field had a population of 3, 9, and 4 larvae per square yard, but here, as was found generally, the infested area was definitely very limited in extent.

In some fields damaged or scarred roots were found in alfalfa, but in most cases the plants seemed to have made complete recoveries. It appears that the most serious damage is done during periods of dry weather when the plants are not able to produce new roots.

A total of 2,350 larvae were obtained in this area; samples were sent to Washington, D. C., for determination, 500 were dissected, and the remainder were preserved or kept for rearing adults or parasites. From those kept for rearing, adults emerged between December 18, 1938, and January 10, 1939.

Santiago del Estero and Fernandez.--Very few larval infestations were found at Santiago. The main commercial crop grown in this area is cotton, although alfalfa and melons, as well as citrus fruits, are produced on a limited scale. One-square-yard samples of soil taken in one alfalfa field of 5 years' standing showed 2, 3, 20, 6, and 3 larvae per square yard. In most fields no larvae were found in samples of 50 plants or more to the field. At Fernandez conditions were about the same as at Santiago.

A total of 175 larvae were obtained in this area. This includes the samples and those obtained by digging up scattered dead or wilted plants. Fifty of the larvae were dissected, some were sent to Washington for determination, and the rest were kept for rearing out adults. Adults emerged from these larvae between December 18, 1938, and January 10, 1939.

Province of Buenos Aires, Including San Antonio de Areco, Pergamino, Sarimento, Jose C. Pas, La Plata, and Buenos Aires.--Throughout the areas in this zone the principal crops are corn, wheat, flax, and alfalfa, and there are quite a few peach orchards in the vicinity of Rosario. Large areas are also devoted to the production of truck and vegetable crops in the areas around the large cities.

Observations for damage and a search for Naupactus larvae were carried out in all types of agricultural plantings, as well as in the pastures and wild growth in this zone. Throughout this whole area no Naupactus infestations of note were found.

Light infestations were found in San Antonio de Areco and Pergamino, and a few scattered larvae were found in Sarimento. The heaviest concentration was found in an old alfalfa field in Pergamino, where five samples produced 18, 4, 3, 6, and 2 larvae to the square yard. In San Antonio the infestations were even lighter and it was very difficult to find any larvae.

Observations made in this area in January indicated that emergence of adults was fairly well along by the middle of the month. Adults were rather hard to find, however, and only solitary individuals were encountered. Sweepings were made in all types of crops, as well as in cocklebur and other wild plants. Very few individuals were taken by sweeping, and the majority of those obtained were found either on plants where damage was noted or on the ground under these plants.

General Pico (La Pampa).--This area has a light sandy soil and a rather dry climate. The principal agricultural crops are alfalfa and wheat.

There have been some rather heavy Naupactus infestations in the neighborhood of Pico, and it was thought that the greatest amount of damage reported was caused by N. densus. The damage to young alfalfa in 1938, in which 350 or more acres were totally destroyed by adult beetles, was reported by Juan Williamson, the experiment station agronomist. This report was verified by several farmers in the neighborhood of Pico. Adult beetles collected in these infested areas and sent to Buenos Aires were determined by Mr. Bosq as N. densus but later discussions with Messrs. Bosq and Williamson regarding the exact origin of the beetles collected and determined indicated some doubt as to their having been collected from those particular infestations, so the determinations should be checked in case of further outbreaks.

Inspections of the alfalfa fields in this region showed that there had been some serious infestations of root-feeding larvae in past years. During the course of these investigations no heavy larval concentrations were found and only 145 larvae were obtained. Six fields of the 33 examined showed serious root damage that had been caused in former years.

San Juan.--This area is principally a grape- and fruit-producing section, but several alfalfa fields were found, as well as large-scale enterprises in the production of truck and garden crops.

Rather heavy though limited Naupactus infestations were found in alfalfa, and some rather serious injury to peppers, in which about 30 percent was destroyed, was reported in 1938. One plot of peppers with a light infestation was found during the present investigation.

In alfalfa the concentrations of Naupactus larvae ranged from 0 to 230 per square yard. The vertical distribution was from 3 to 34 inches below the surface of the soil. In general the greatest concentrations were in the first 6 to 7 inches of top soil, but in one case the greatest

density was found at a depth between 21 and 34 inches below the surface.

About 2,890 larvae were obtained in this area, 300 of which were dissected, while most of the remainder were kept for rearing. A few adults emerged from these during the latter part of January and February, but most of them were still in the larval and pupal stages and were destroyed the latter part of February before Brazil was entered.

In the majority of alfalfa fields, or in other types of vegetation, it was difficult to find Naupactus larvae or indications of their presence. The affected zones were in all cases limited to small areas within fields, and on the whole little damage could be attributed to the presence of the beetle larvae.

Mendoza and San Luis.--Mendoza is chiefly a grape- and wine-producing center, although a variety of other fruits and quite a lot of alfalfa are produced in this area. A brief survey indicated a very low Naupactus population in this zone. San Luis has had a series of droughts, and the agricultural production has been reduced almost to zero for the last 6 or 7 years. Indications were that Naupactus infestations were practically nonexistent, but there were so few places to investigate, owing to the lack of plant life, that very little time was spent in this area.

Uruguay.--In general, Naupactus infestations were found to be more prevalent and generally distributed in Uruguay than in Argentina. Light infestations were found in the vicinity of Montevideo and throughout the western part of the country extending from Montevideo to Salto. The infestations varied a great deal in intensity as well as in development, but light populations could be found in almost any area where sufficient scouting was done. On the whole, little noticeable damage could be attributed to Naupactus, but there were a few cases in which as much as 25 percent of the alfalfa stands were, or apparently had been, destroyed by Naupactus larvae. Damage or infestations were seldom found in alfalfa fields of less than 3 years' standing.

The heaviest infestations found had populations of 20 to 96 larvae per square yard, but there had been quite a little emergence of beetles in the region from Paysandu north before the samples were taken. Feeding scars on the alfalfa roots indicated that the infestations had been much heavier.

Development near Montevideo appeared to be very much retarded, and there had been very little emergence of beetles and little pupation up to the latter part of February. On the other hand, in Paysandu, a little farther north, it was estimated that half or more of the larvae had developed into pupae or adults. In Salto, the northernmost point visited in Uruguay, emergency appeared to be practically complete and practically no larvae could be found. A total of more than 1,000 Naupactus larvae were examined in Uruguay but no indications of parasitism were found.

ADULTS

Naupactus adults were collected in Jose C. Pas, Santa Fe, and San Antonio de Areco in Argentina and in Montevideo, Paysandu, Colonia, and Rivera in Uruguay. In Brazil adults were found only in the following towns in the State of Rio Grande Do Sul: Sant'Anna, Santa Maria, Santa Cruz, and Porto Alegre.

There were 626 adults collected, 47 of which were from Argentina, 510 from Uruguay, and 69 from Brazil. Dissections showed no indications of parasitism nor were any indications of external parasitism found. In addition to the above, several dead adults were found but no cause for their death other than natural mortality could be given.

Many species of hunting wasps of the family Cerceridae are known to stock their nests with adult weevils, and it was thought that Naupactus leucoloma and other naupactines might be preyed upon by them more generally than by other groups of parasites or predators. Only a limited amount of time was available for making special investigations on this group, and no representatives of the family were found during the period when adult beetles were present in the field. The low beetle population made detection of natural enemies of this type exceedingly difficult. Excavations of a few solitary wasp nests were made in the vicinity of Rio de Janeiro, but they were stored with lepidopterous larvae. In general, the nests of these wasps would probably be in exposed areas of sparse vegetation that naturally would not be explored for Naupactus larvae. Mr. E. J. Hambleton plans to make observations on Cerceridae when naupactines appear in sufficient numbers for study. This will probably be about December or January.

Observations in Brazil in Sao Paulo, Campinas, Riberom Preto, and the areas around Rio de Janeiro indicate that Naupactus leucoloma does not exist in these zones. In fact all types of naupactines were scarce during March and April. There were no examples of Brazilian N. leucoloma in the museum collections.

EGGS

Naupactus eggs were not found in the field, although as thorough a search as possible was made wherever adult beetles were encountered. All plants on which adult beetles were found feeding and the surrounding plants were pulled up and examined, as well as the grass stems and other debris on the ground near the base of the plants. In most cases adults were solitary, and in places where there was a thick mat of wild grass it would be almost impossible to find eggs unless they appeared in quite large numbers. In the plowed fields, however, it appears that eggs should have been found on plant stems had there been any present. Observations were somewhat early for eggs in the sections where adults were found in reasonable numbers.

An attempt was made to get some idea of the presence of egg parasites and the effect of ants or other controlling agencies that may be responsible for their destruction by exposing egg masses in the field.

There were 237 adult beetles from Paysandu, to which 23 from Salto and 10 from Montevideo were added for oviposition. From this lot a total of 540 egg masses were obtained in the rearing cages. The beetles were fed on cocklebur and alfalfa.

The egg masses were exposed in the Naupactus-infested fields in the region of Montevideo for periods ranging from 3 to 10 days. The samples were all collected before Montevideo was left, and portions of each exposed lot were later dissected to determine whether or not they were parasitized. In no case was there evidence of parasitism, and eggs exposed in areas where ants were abundant were still intact on the sticks when they were collected.

The egg masses that were not dissected were placed in vials (10 to the vial) and kept until March 20, after which they were moistened and left in the glass vials for development. Between March 20 and 31 development of 165 of the 200 egg masses was observed, and dissection of the remaining material indicated a high percentage of hatch but no evidences of parasitism. There were 35 egg masses that did not develop. They appeared to dry up and form a hard mass.

The scale on which these experiments were conducted was too limited for definite conclusions but would indicate that egg parasites, if they are in this zone, are not abundant.

CONCLUSIONS

Distribution.--Naupactus leucoloma is generally distributed throughout a large area in South America, extending from the Provinces of San Juan and La Pampa or farther south, as it has also been reported from Rio Negro, and to Jujuy and Santiago del Estero or farther north in Argentina. It is generally distributed throughout Uruguay and was found in limited numbers in a few areas in the State of Rio Grande Do Sul, Brazil. It appears conclusive that N. leucoloma does not exist in the State of Sao Paulo or in Rio de Janeiro, Brazil. In the northern part of Argentina, Calilegua and Ledesma, for example, the beetle seems to disappear entirely. This survey, substantiated by the absence of N. leucoloma specimens in the museum collections, indicates that N. leucoloma does not exist in the strictly tropical zones of South America, although it occurs in the subtropical regions.

Life history and habits.--The life history and habits of Naupactus leucoloma in South America correspond in a general way to those of the beetle in North America.

Emergence of adults.--The adult beetles emerge from December to March or later, this corresponding to June to September in the northern hemisphere. The time of emergence probably varies from year to year according to the season. It also varies a great deal in different parts of the country. Good examples of this were found in Uruguay in January and

February, where the adults were practically all out in Salto, about half had emerged in Paysandu, while a very small percentage of the larvae had transformed to pupae or adults in Montevideo. The distance between these points is only about 250 to 300 miles."

Information on the time of emergence in Argentina is rather limited, but adults were collected in the Provinces of Buenos Aires and Santa Fe during the first part of January. Larvae collected in Tucuman and Santiago del Estero produced adults between December 18 and January 10. Adults probably emerge earlier than this in these sections under natural field conditions, as the temperature was higher and the season was somewhat more advanced there than in the localities where the larvae were held for development. Larvae collected in San Juan produced adults during the latter part of January and in February, but emergence was not nearly complete at that date and all material was examined and destroyed before Brazil was entered.

In Paysandu, Uruguay, adults were ovipositing by February 15, which indicated that emergence had taken place by the first of the month, and in Salto it was probably somewhat earlier.

The eggs are deposited during the summer and fall, or from January to May or later. When supplied with sufficient moisture they hatch within 15 to 20 days, and the larvae start feeding but do not complete development until the following spring. Apparently there is one generation a year, and few if any larvae carry over in the soil for a second season.

Food habits of larvae and adults.--Information on native food plants of the larvae was not obtained. The larvae were hard to find in practically all types of cultivated or wild land except that planted to alfalfa. In alfalfa there were very few infestations of plantings that had not attained an age of 3 to 5 years. The larvae do feed on other plants, and light to medium populations were found in fields that had been planted to cowpea and velvetbean the previous season. They were also found feeding on peppers. No infestations of any importance were found in soil bearing native vegetation, and no clues regarding the original preferred host plants of the beetle larvae were discovered.

Adults were found feeding on cocklebur, alfalfa, peanuts, and some legumes. No attempt was made to obtain data on host plants in the laboratory.

Economic importance.--Naupactus leucoloma appears to be of little economic importance in South America. Infestations of any significance were generally so limited in extent, and the cases of this nature were so rare in all types of vegetation examined, except alfalfa, as to be practically negligible. There was one case of larvae doing considerable damage to peppers, and two infestations were found in bean and pea fields, but such instances are undoubtedly very rare. Damage by Naupactus had never been reported in South America previous to 1938.

The amount of damage to alfalfa is hard to estimate. In the first place the affected areas were generally small and, in addition, the plants, in most cases, seem to recover fully from the damage unless the attack is followed by drought. Practically all infestations were found in stands of 3 to 5 years or more, and the roots were consequently quite large. Damaged areas in fields could be spotted by the poor growth, and in many cases plants were killed but only on a very limited scale. Many of the apparently killed plants revived and put out new growth from the roots after rains or irrigation.

Histories of several successive infestations were found in several alfalfa fields of some years standing. Small areas in which there were relatively heavy infestations, with plants showing injury, proved upon examination to support considerable numbers of Naupactus larvae. In the same fields areas were examined and damaged roots found, but larvae were not present. Inspection of the feeding scars showed that the damage had been caused in previous years and that the plants had fully recovered.

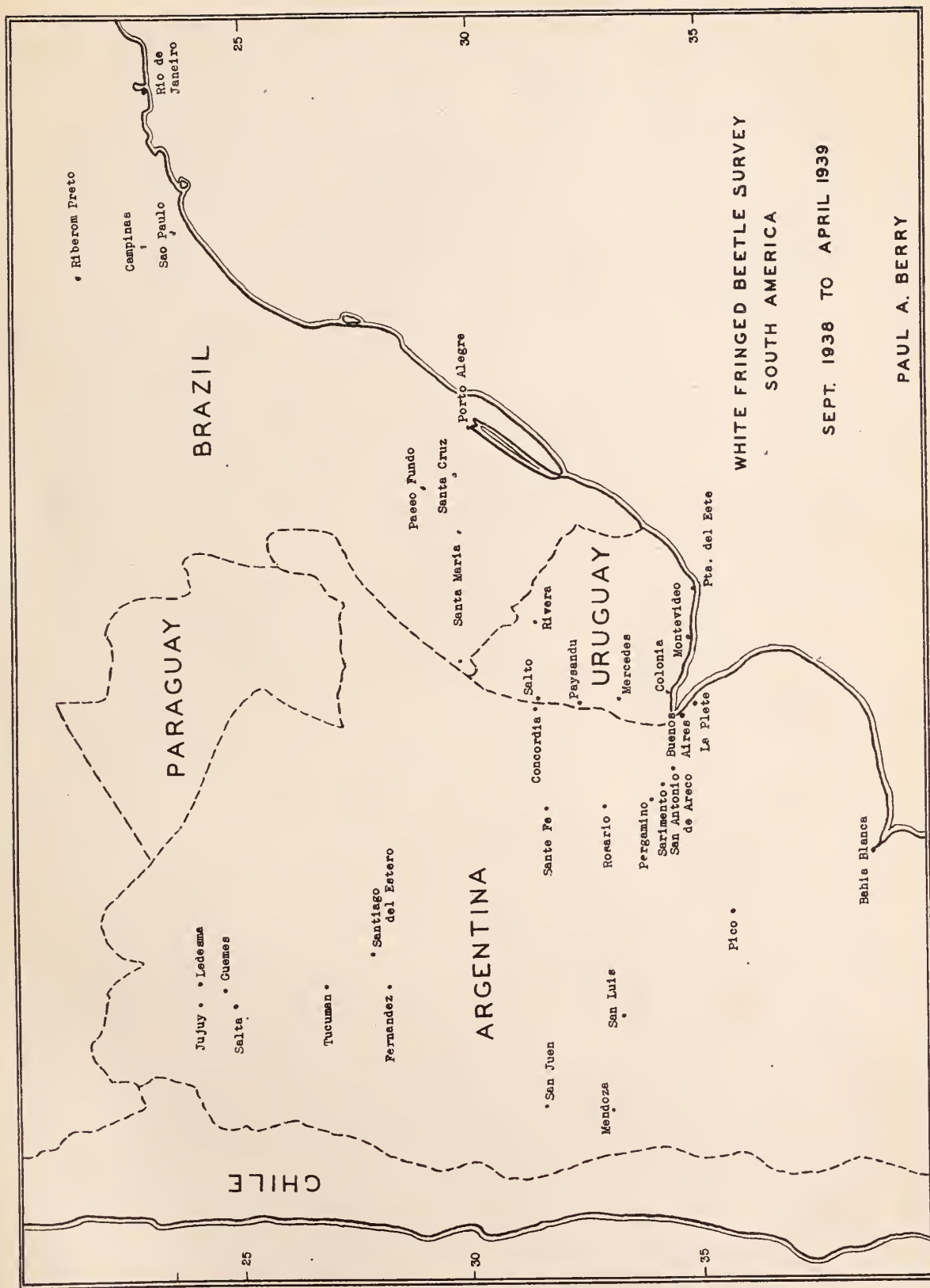
It appears that the Naupactus populations shift from year to year within the same field and do not infest the same spot in successive seasons. Whether this shifting is due to the fact that the plants on which the larval feeding takes place are less palatable to the adults, which prevents them from feeding or ovipositing, or whether it is due to the migratory nature of the insect, or to some other cause, is not known.

It is difficult to explain why the Naupactus infestations do not become more dense and general, especially in the older alfalfa fields. In General Pico there had been some rather extensive infestations of Naupactus densus or N. leucoloma in 1937 and 1938. A history of some heavy and extensive larval populations was well recorded on the alfalfa roots in a few fields, but very few larvae were found there in the 1938-39 spring season. Apparently the adults had migrated out or had died before ovipositing. There was also serious damage by migratory adults to young alfalfa in this area in the summer or fall of 1938.

Natural enemies.--The possibility of finding parasites, or other biological agencies, that exert any considerable degree of control on Naupactus leucoloma seems rather unlikely. During the course of these investigations more than 7,000 Naupactus larvae were examined for external parasites, and representative samples of 20 to 500 larvae from each locality were dissected for internal parasites. No indications of parasitism were observed during the whole course of the investigations.

A total of 62 adults were collected and examined for evidences of external parasite eggs. A representative sample of more than 200 were dissected for evidences of internal parasitism, and the 200 used in oviposition experiments to obtain eggs for exposure in the field were dissected or kept for evidences of internal parasites, but results were entirely negative. These numbers were not large but may be considered as representative in view of the relatively small number of adults available.

Eggs were not found in the field, but 540 masses from the oviposition cages were exposed at Montevideo in fields that supported Nau-
pactus larval infestations. Examinations of the eggs failed to show any indication of parasitism.



WHITE FRINGED BEETLE SURVEY
SOUTH AMERICA

SEPT. 1938 TO APRIL 1939

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